

M E A D O W S



*Measuring Meadow to Determine Quantity of Seed
Hollywood Elementary School
St. Mary's County Public Schools*

Case Study: Meadows

In the Spring of 1996, Hollywood Elementary School (St. Mary's County) students in first grade through fifth grade were involved in converting approximately 1/4 acre of lawn on the school site to a wildflower meadow. The students in each of the classes participated in various pre- and post-investigations, in addition to planting a section of the meadow. Technical support for the project was provided by Rich Mason of the U.S. Fish and Wildlife Service and Mary Piotrowski, naturalist and school volunteer.

Several pre-planting investigations were part of the meadow project:

- Conducted a Wildlife Habitat Comparison of an existing meadow (old farm field) and a mowed lawn. Using hula hoops to select random sample areas in the meadow and the lawn, the students compared plant diversity, food sources, cover, and evidence of wildlife.
- Compared survival rates of tricolor pasta which represented "camouflaged prey" in the meadow and in the lawn. Students acted as predators and searched for the "prey" in each habitat to draw conclusions about which habitat provided better cover for the "pasta animals," and which color animal was better adapted to each respective habitat.

- Researched the amount of pollution generated by the lawn mowers used to mow the lawn, and how much money would be saved by converting the area to a meadow.
- Observed the sun's movement across the planting area. Students made drawings of the area at times throughout the day to record the amount of sunlight and shade reaching different parts of the area.
- Tested the soil to determine how compacted the soil is and how well it drains.
- Used trundle wheels to measure the planting site. Students then calculated the area of the site.
- Calculated the amount of seed needed. Approximately 5 lbs of seed was used per acre.
- Compared the composition of the two seed mixes used. Students used a Venn diagram to show which seeds were common to both mixes and which seeds were present in only one of the mixes.
- Researched what kinds of birds, butterflies, and other animals will be attracted to the plants listed in the seed mixes.



*Raking Soil in Preparation for Hand Broadcasting Seed
Hollywood Elementary School
St. Mary's County Public Schools*

Two different seed mixes were used. The U.S. Fish and Wildlife Service provided one mix and the P.T.A. purchased a different variety. One mix was planted in one half of the planting area and the other mix in the other half. After two years, there does not appear to be a significant difference between the two mixes. Some of the seed mix was reserved to plant in bare spots the following Fall. The seed mixes were still viable after one to two years of storage in the refrigerator. To make it easier for the children to broadcast the seed, seed was mixed with sand. The sand acted as a carrier, making it possible to spread the seed more evenly. In addition, because the sand was a different color than the soil, the children were able to see where they had spread the seed.

After eradicating the existing lawn, a local farmer tilled the area with a tractor. The area was divided into eight sections. Students in two classrooms were responsible for one section. The students began raking to loosen the soil. The sections that had been raked more had better success.

Naturalist Mary Piotrowski worked with each of the classes as they planted. The students used the following procedure:

- Rake the soil.
- Practice broadcasting sand without seed in a non-planting area.
- Broadcast the seed ("Feed the chickens").
- Rake the seed into the soil.
- Stomp the area with your feet (Do the "Meadow March").
- Spread straw over the area.
- Water with a sprinkler.

Several post-planting investigations were conducted:

- Writing letters to another school to explain the benefits of planting a meadow and the method used.
- Monitoring the growth of the meadow.
- Keeping a log of the wildlife that visits and inhabits the meadow.
- Putting socks over the students' shoes to collect and observe seeds.
- Making observational drawings of the wildflowers and using field guides to identify them.

The meadow requires very little maintenance. The meadow is mowed once a year in the Fall to disperse the seeds and to maintain it as a meadow.

The school staff is very pleased with the success of the Meadow Planting Project. The project continues to benefit the students each year by enabling them to experience and interact with the meadow firsthand, and understand the importance of the meadow ecosystems and its connectedness to other ecosystems. Converting an area of unused lawn to meadow has increased its habitat value for wildlife and its educational value for the students.

Environmental Enhancement

A meadow is a grassland with a mixture of wildflowers and native grasses. In the eastern United States where moisture is abundant, meadows are usually temporary and, if left alone, will succeed into a woodland. Historically, there were more meadows in the East than there are today as fires set by lightning and Native Americans kept trees out of certain areas and allowed meadows to thrive. Grazing by animals that once existed in the East, including elk and bison, also helped perpetuate Eastern grasslands.

Meadows provide a unique habitat for a variety of plants and animals. Native grasses form the primary structure of meadows. Unlike the turf forming nature of lawn grasses, many of the native grasses grow in bunches. The bunch forming habit creates nesting spaces and travel corridors for a variety of birds including bobwhite quail, bobolinks, meadowlarks, ground nesting sparrows and many other birds. Rabbits, voles and other small animals take advantage of this bunch-like structure. The wildflower or forb component of meadows provide additional structure but more importantly provide nectar and seeds for birds, mammals and many insects. Insects are vitally important as they are at the base of the Earth's food web and provide the free service of pollination. A variety of fascinating butterflies abound in meadows. Predators including hawks and foxes are attracted to the abundance of prey species in meadows.

Meadows, like forests and wetlands, provide protection to streams and, ultimately, the Chesapeake Bay as the thick vegetation allows rainwater to slowly percolate into the ground filtering out pollution. Recharged groundwater delivers cool, clean water to streams.

Restoring grasslands is a high priority to biologists as the acreage of this habitat has dwindled to a critical level. Only one percent of the original prairie remains of the huge grassland that once stretched from the Ohio Valley to the Rocky Mountains. Acreage of Eastern grasslands are also at an all time low.

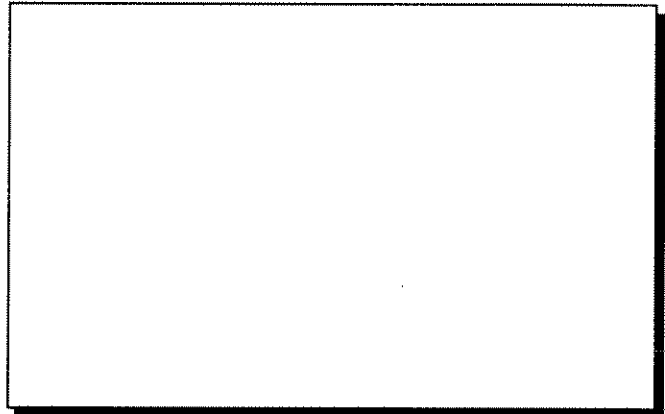
Contribution to Educational Programs

Once a meadow is established there are many hands-on instructional activities that can be developed. A meadow is a rich resource for students. Younger students can use the meadow to visualize and describe colors, shapes, textures, and smells. Children can learn to write, spell, and read words and sentences related to the meadow. Leaves, flower petals, seeds, and insects can be used to teach introductory mathematics. Older students can keep a journal about the meadow through the entire year making observations and entries once a week. From their journal entries, students can develop an information fact sheet about the meadow, complete a creative writing task or develop a play or skit about some aspect of the meadow. World geography can be learned by mapping grassland habitats around the world. A wealth of science investigations that also incorporate mathematics and language arts can be taught using the meadow. Habitats, birds, plants, insects, pollination, soil, water cycle, and photosynthesis, are just a few of the many science topics that can be taught using a meadow.

Planning, Design, and Construction

Most areas on a school site not designated for a specific use are typically seeded in turf-grass. These areas are excellent candidates for meadow establishment. Meadows can be planted over septic drainfields as a low maintenance option to turf. An ideal place to establish a

meadow is on embankments including those within stormwater management ponds. The National Resource Conservation Service has seed mixes for embankments (See Table 3).



Seedmixes for Dams/Spillways and Embankments Table 3
(Natural Resource Conservation Service)

On existing school sites, proper ground preparation is critical for desired results. Turf-grass and weeds are very aggressive and should be removed.

The size of the meadow is related to available space. A meadow can range from a 100 sq. ft. meadow garden to several acres. A large meadow will provide many more environmental benefits than a smaller one. When designing the shape of the meadow, plan for gentle curves as opposed to straight lines. Mowed trails should be an integral part of larger meadows.

A commonly asked questions is, "Can we let the lawn grass grow to establish a meadow." The answer is yes; however, turf grasses and weeds that make up school lawns will not develop into a colorful and interesting meadow of native plants. If the area is to be managed as a meadow, then it is best to remove existing turf and weeds, and plant meadow seeds or plants. However, if the long term plan is to allow the area to evolve into a woodland then the lawn grass can be left to grow. Grasses and weeds will eventually give way to colonizing tree seedlings as a young forest develops.

Site Selection

A meadow can be planted almost anywhere that has at least 6 hours of sunlight during the growing season. If plants (including grass) are already growing on the potential site, it is likely the soil is suitable for meadow establishment. Be aware that tall meadow grasses can block the vision of motorists near intersections and bus travel lanes.

After the site is selected, gather information about the growing conditions that include sunlight, soil texture, and soil moisture. This information will allow selection of an appropriate species mix.

Sunlight - A minimum of 6 hours of sunlight is needed for meadow plants.

Soil Texture - Determine if the soil texture is *clayey*, *sandy* or an intermediate soil texture called *loam*.

Moisture - Decide if the site is wet (puddles remain for several days or weeks after hard rains), very well drained (puddles do not form after rain) or moderately well drained (average soil drainage). Soil moisture in most situations is directly related to the soil texture. For example, clay soils are generally wetter since they drain slowly and sandy soils are generally dry since they drain quickly.

Note: To have your soil professionally evaluated, bring a sample to your local Soil Conservation District Office or send a sample to the Cooperative Extension Service (see Appendix B).

Plant Selection

It is important to select species that are adapted to the soil and moisture conditions of the site. Locally native plant species should be used as these are best adapted to local climate and soil conditions. Be cautious of mixes in seed catalogs called "Northeast or Southeast Mix" as these usually only contain a few plants native to the region. Students can research and develop their own mix using seed catalogs or site information can be given to a seed supplier to develop a mix.

A good mix contains 50% perennial wildflowers and 50% native grasses. A cover crop of oats and barley at 20-40 lbs/acre should be used on sites with exposed soil to prevent erosion. A cover crop is not needed in no-till applications (see discussion of mechanical seed drill method on page 39). Most perennial wildflowers will take 2-3 growing seasons before blooming. Seeds planted in the spring will begin to bloom the following spring or later. Patience is important.

For sites less than 1,000 sq. ft. plants are often used although seeds can be used. Plants will give quicker results. For larger sites, seeds should be used. For larger seeded sites, the seeded area can be supplemented with plants. Plants will provide blooms the first growing season.

Recommended seeding rates vary widely from between 6 and 15 pounds per acre. When ordering seeds, inquire about the optimum rate for your site. If using plants, space on 2' centers.

Ground Preparation and Seeding Method

Hand broadcasting seed and using a mechanical seed drill are the two seeding methods outlined. Several ground preparation approaches are provided depending on the size of the project. Select the ground preparation option that best fits the needs of the project and be diligent about completing the recommended steps. The best success is achieved with thorough ground preparation.

Planting a meadow on a new construction site is less difficult than an existing site where turf must be removed. There are a few basic tips to follow for newly graded sites. Topsoil should be saved and spread across the site. Do not use fertilizer as meadow plants are adapted to low fertility soils and fertilizers promote weed growth. Do not use lime as this also encourages weeds. Use the hand broadcast or mechanical seed drill method (see following discussion). When hand broadcasting, roll the site after seeding to ensure good seed to soil contact. When using the mechanical seed drill, firmly pack the seed bed before seeding. Hydro-seeding is not recommended as results have not been satisfactory. At

the same time the meadow is planted, spread 20-40 lbs/acre of oats or barley seed for quick cover to stabilize the soil. Finally, lightly cover the site with a clean straw mulch.

On existing school sites, turf must be diligently removed before seeding is done. Several methods are explored in the following discussion.

The seeding recommendations that follow recognize that wildflower seeds germinate better when planted in the fall and that grass seeds germinate better when planted in the spring.

Hand Broadcasting - Hand broadcasting seed is feasible on sites up to an acre. Depending on the size of the meadow, equipment needed for ground preparation varies from shovels and rakes to a disc pulled behind a tractor. More ground preparation steps are involved with this method compared to using a mechanical seed drill. An option for larger areas is to divide the site into smaller sections and complete one section each year by hand broadcasting. The benefit to this approach is that many students can be involved over time. Students can collect seeds from established sections to plant the next section.

GROUND PREPARATION FOR HAND BROADCASTING SMALL SITES WITH EXISTING TURF:

OPTION 1:

June - August

Remove the sod by using a sod cutting machine. Be sure to remove all the roots of the grass. A sod cutting machine can be rented from a tool rental store. Next, lightly till or rake the soil. Water the soil to stimulate the germination of dormant weed seeds. Wait for two weeks of warm weather to allow dormant weeds to germinate. Roto-till or disc the site one to three times waiting two to three weeks between each tilling.

October - November

Plant approximately 3/4 of the wildflower seed and 1/4 of the grass seed following the instructions for hand broadcasting (page 39).

April

Plant approximately 1/4 of the wildflower seed and 3/4 of the grass seed following the instructions for hand broadcasting.

OPTION 2:

March - May

Remove the sod and cover the site with black plastic. Cover with mulch to hold the plastic in place. This process should kill any remaining weeds or grass.

October - November

Remove the plastic. Plant approximately 3/4 of the wildflower seed and 1/4 of the grass seed following the instructions for hand broadcasting.

April

Plant approximately 1/4 of the wildflower seed and 3/4 of the grass seed following the instructions for hand broadcasting.

GROUND PREPARATION FOR LARGE SITES WITH EXISTING TURF:

April - September

Remove the sod with donated or rented equipment. Roto-till or disc the site several times waiting 2-3 weeks between each tilling. Each time more grass and weeds will be removed.

October - November

If the seed bed appears to be mostly weed free two weeks after the last tilling, plant approximately 3/4 of the wildflower seed and 1/4 of the grass seed following the instructions for hand broadcasting.

April - May

Plant approximately 1/4 of the wildflower seed and 3/4 of the grass seed following the instructions for hand broadcasting.

Sample Meadow Mixes for the Mid-Atlantic

The following are three mixes containing species native to Maryland that are available from seed suppliers. The mixes give a range of bloom colors that will be present from late May to October. The lists are provided as a general guideline. Most seed suppliers have ecologists that can be very helpful in developing seed mixes to meet specific needs.

DRY SOIL (mostly sandy to loamy)

FLOWERS

Butterfly Milkweed (*Asclepias tuberosa*)
Common Milkweed (*Asclepias syriaca*)
Heath Aster (*Aster ericoides*)
Partridge Pea (*Cassia fasciculata*)
Showy Tick Trefoil (*Desmodium canadense*)
Purple Coneflower (*Echinacea purpurea*)
Wild Blue Lupine (*Lupinus perennis*)
Wild Bergamot (*Monarda fistulosa*)
Black-Eyed-Susan (*Rudbeckia hirta*)
Gray Goldenrod (*Solidago nemoralis*)

GRASSES

Little Bluestem (*Schizachyrium Scoparium*)
Indiangrass (*Sorghastrum nutans*)
Canada Wild Rye (*Elymus canadensis*)

MEDIUM SOIL (loam to silty clay loam)

FLOWERS

Butterfly Milkweed (*Asclepias tuberosa*)
Common Milkweed (*Asclepias syriaca*)
New England Aster (*Aster novae-angliae*)
Zig-Zag Aster (*Aster prenanthoides*)
Flat-Topped White Aster (*Aster umbellatus*)
Showy Tick Trefoil (*Desmodium canadense*)
Purple Coneflower (*Echinacea purpurea*)
Wild Blue Lupine (*Lupinus perennis*)
Wild Bergamot (*Monarda fistulosa*)
Black-Eyed-Susan (*Rudbeckia hirta*)
Stiff Goldenrod (*Solidago rigida*)
Hoary Vervain (*Verbena stricta*)

GRASSES

Little Bluestem (*Schizachyrium Scoparium*)
Canada Wild Rye (*Elymus canadensis*)
Indiangrass (*Sorghastrum nutans*)

WET SOIL (typically high clay content)

FLOWERS

Swamp Milkweed (*Asclepias incarnata*)
New York Aser (*Aster novi-belgii*)
Nodding Bur Marigold (*Bidens cernua*)
Joe-Pye Weed (*Eupatorium fistulosum*)
Spotted Joe-Pye Weed (*Eupatorium maculatum*)
Boneset (*Eupatorium perfoliatum*)
Rough-Leaved Goldenrod (*Solidago patula*)
Blue Bervain (*Verbena hastata*)
Ironweed (*Vernonia fasciculata*)

GRASSES

Big Bluestem (*Andropogon gerardii*)
Eastern Gama Grass (*Tripsacum dactyloides*)
Switchgrass (*Panicum vergatum*)
Fox Sedge (*Carex vulpinoidea*)
Soft Rush (*Juncus effusus*)
Sensitive Fern (*Onoclea sensibilis*)

Table 4

STEPS FOR HAND BROADCASTING SEED:

1. To ensure even distribution of seed, mix seed with 3-5 parts moist sand, sawdust or peat moss medium. Moisten the medium to allow the seed to stick.
2. To ensure good coverage, use 1/2 the mix and spread evenly in one direction then spread the other half walking perpendicular to the first pass.
3. Lightly rake or drag a piece of chain link fence across the soil to ensure good soil to seed contact.
4. Compress the soil to ensure soil to seed contact by rolling, having children stomp throughout the entire site, or drive over site with a vehicle.
5. Seed germination is increased if straw mulch is lightly spread across the site. The straw keeps soil moist allowing for better seed germination.
6. The options above recommend planting in the fall and early spring. If planting in late spring or early summer, watering can enhance germination.

Combination Mechanical Seed Drill/Hand Broadcasting Methods

- Establishing a meadow using a mechanical seed drill is a simple and effective method. The mechanical seed drill method is generally used only on large sites since the drill is pulled behind a tractor. Special mechanical seed drills must be used due to the fluffy nature of the native grass seeds. Several drills (referred to as Truax or warm season grass drills) are available for loan through the Maryland Department of Natural Resources, Soil Conservation Service or National Wildlife Refuges. Some landscape contractors have the special drill and can be hired to prepare the ground and plant the meadow. If assistance is planned from volunteers such as a local farmer, an experienced person from a natural resource agency or contractor should be on hand to supervise the seeding. If a local farmer agrees to help, make sure the hydraulic connection is compatible between the tractor and drill.

If a mechanical seed drill is used, some seeding should be reserved for students to plant using hand broadcasting. This allows students to be involved in the planting.

GROUND PREPARATION:

April - September

Roto-till or disc the site several times waiting two to three weeks between each tilling. Each time more grass and weeds will be removed.

October - November

Roll the site to create a firm seed bed then plant 1/2 of the wildflower seed with students using the hand broadcasting method.

April - May

Using the mechanical seed drill, plant the remainder of wildflower and all of the grass seed.

Long Term Maintenance

A yearly maintenance plan needs to be developed with the grounds supervisor. A mower or bush-hog that can adjust to a height of 6'' - 8'' is needed for proper maintenance.

The first year requires special attention to reduce weeds. Remove weeds by hand on small sites. For large sites, mow to a height of 6'' - 8'' every six weeks. Mowing eliminates annual weeds before going to seed and will not harm new wildflower seedlings and native grasses. If weeds are not evident, mowing is not necessary.

Beyond the first year, annual mowing is needed. Divide the meadow into two or three sections. Mow one section each year on a rotation before April 1st or after August 31st to avoid the nesting season of small mammals and ground nesting birds. An optional mowing schedule to allow the most cover for wildlife is to mow 1/3 of the site every March. Mowing only a section each year allows cover for wildlife to remain at all times. Butterfly and other insect larvae will survive in the uncut portion. For cutting small sites, a weed whacker or scythe can be used.

After mowing, remove cut material and thatch to sustain the meadow. This practice opens the soil to light promoting the growth of new meadow plants. Removing thatch can be done with a hand rake on small sites or a mechanical rake pulled behind a tractor on large sites. A second method to remove thatch is a controlled burn. Fire is used by grassland managers as a very effective

method to remove thatch, remove woody species, and promote new growth. In the Midwest, where prairie restoration has been underway since 1970, burning is an accepted and necessary management practice even on school grounds. Strict precautions are necessary if burning is done on school grounds. Contact your local fire department or a specialist from the Maryland Department of Natural Resources to oversee a controlled burn.

Cost

In addition to the environmental benefits, there is a significant economic incentive to transforming unused turf areas into meadow. Once a meadow is established, mowing is done once a year for a portion of the meadow as opposed to 12-15 times a year for an entire lawn. Along roadsides, through power line right-of-ways and on corporate commons, meadows are established to significantly reduce maintenance costs while providing an excellent environmental benefit. School systems can also benefit from this landscape practice.

The seed cost for a meadow can range from \$400 - \$1,200 an acre depending on seed source, seed quantity, and species mix. Seed companies can tailor a mix to your budget.

Student Participation

There are many opportunities for students to be part of the planning, design, and planting of a meadow. Their involvement depends on the method that is used to establish the meadow. At the very least students can:

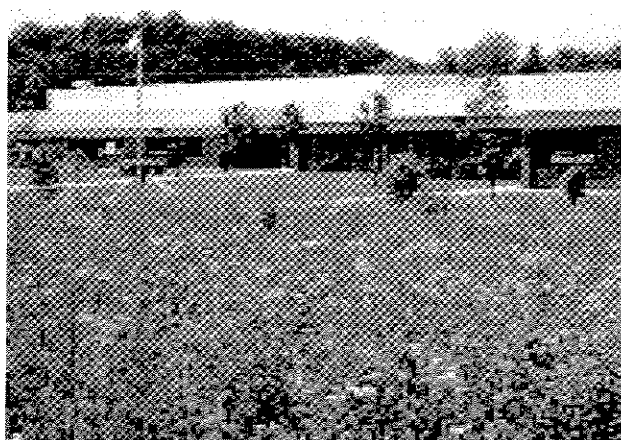
- Measure, plot, map, and calculate the size of the meadow.
- Determine how many pounds of seeds are needed based on the area.
- Determine if the soil is sandy, loamy or clay, how moist the site is, and use this information to research and select species from a seed catalog.
- Contact community members for assistance with tilling, seed drills, etc.
- Apply for a grant.
- Hand broadcast the seed.
- Monitor seed germination.

Safety

Ticks are a concern with tall grasses. Students should not wade through the meadow. Mowed trails should be used for access. Students should check for ticks each time the meadow is used and parents should be aware of the possibility that their children may pick up ticks.



BEFORE: Meadow Development
Seven Oaks Elementary School
Baltimore County Public Schools



AFTER: Completed Meadow
Seven Oaks Elementary School
Baltimore County Public Schools